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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

RIFC
LOCAL FLOODS

Memorandum Report

Flood of August 2-3, 1951

Buckhorn Creek and Other Tributaries

Near Fort Collins, Colorado

Forest Service
U. S. Department of Agriculture
December 10, 1951

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Introduction

This report summarizes field observations and data on the watershed conditions of Buckhorn, Redstone, and Labeau Creek Watersheds in or near the Roosevelt National Forest west of Fort Collins, Colorado and their relation to the floods resulting therefrom following the storm of August 2-3, 1951.

A preliminary reconnaissance of the watershed area within the intense portion of the storm was made on August 8 and 9 by a Forest Service group consisting of personnel from the Roosevelt National Forest, Region 2, Washington Office, and Intermountain Forest and Range Experiment Station. As a result of this field inspection a joint report was sent to the Washington Office by telegram on August 10.

The isothystal map was furnished by the Bureau of Reclamation. Rainfall amounts from the Fort Collins and Boulder gages were furnished by the Weather Bureau. The flood hydrograph of Buckhorn Creek at Masonville was obtained from the Geological Survey. Complete data concerning flood damages obtained by the Corps of Engineers were not available at the time the report was being prepared but will be forwarded later. Data and photographs on watershed condition and flood results were furnished by the Roosevelt National Forest and members of the Regional Office of Region 2 of the Forest Service. This report was prepared by the Flood Control Division of the Intermountain Forest and Range Experiment Station.

Watershed Description

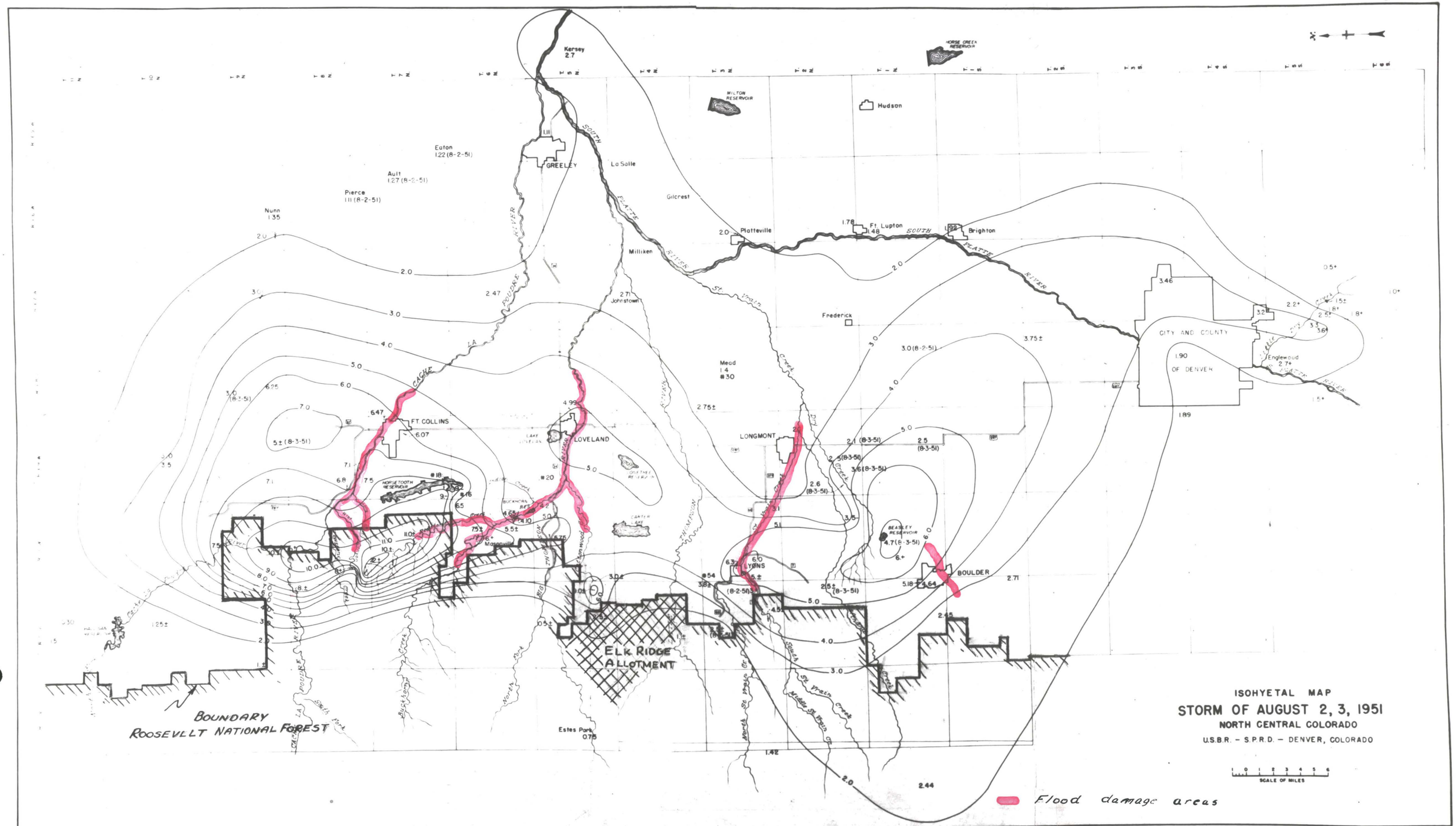
On August 2 and 3 heavy rains and flash floods occurred along the foothills in the South Platte Watershed from Boulder to Livermore. The area covered by this report includes some 65 square miles in the Roosevelt National Forest west of Fort Collins, Colorado. This area is drained by Rist Canyon, Labeau Creek, Redstone Creek, Buckhorn Creek, and other minor tributaries. The greater portion of the area is mountainous with narrow valleys and steep slopes lying west of the frontal hogbacks which are located between the high plains and the front range of Colorado.

Map 1, prepared by the Bureau of Reclamation, shows the total storm area. Map 2 shows the intense portion of the storm on the Roosevelt National Forest west of Fort Collins, Colorado.

Description of Storm

Rains covering an area from Boulder to Livermore, Colorado along the base of the front range began about 7:25 p.m. on August 2, accumulated about 3.05 inches that night, as recorded at the Fort Collins gage. The ranchers in the Redstone area have estimated the August 2 rain at 4 to 5 inches. They stated that the August 2 storm was not of high intensity and lasted all night. Table 1 shows the rainfall depths by hourly amounts from recording gages at Fort Collins and Boulder. This rain served to saturate the soil and did not cause serious runoff. The rain of August 3 began in the early evening and about 3.03 inches fell at Fort Collins largely before midnight. The

Figure 1



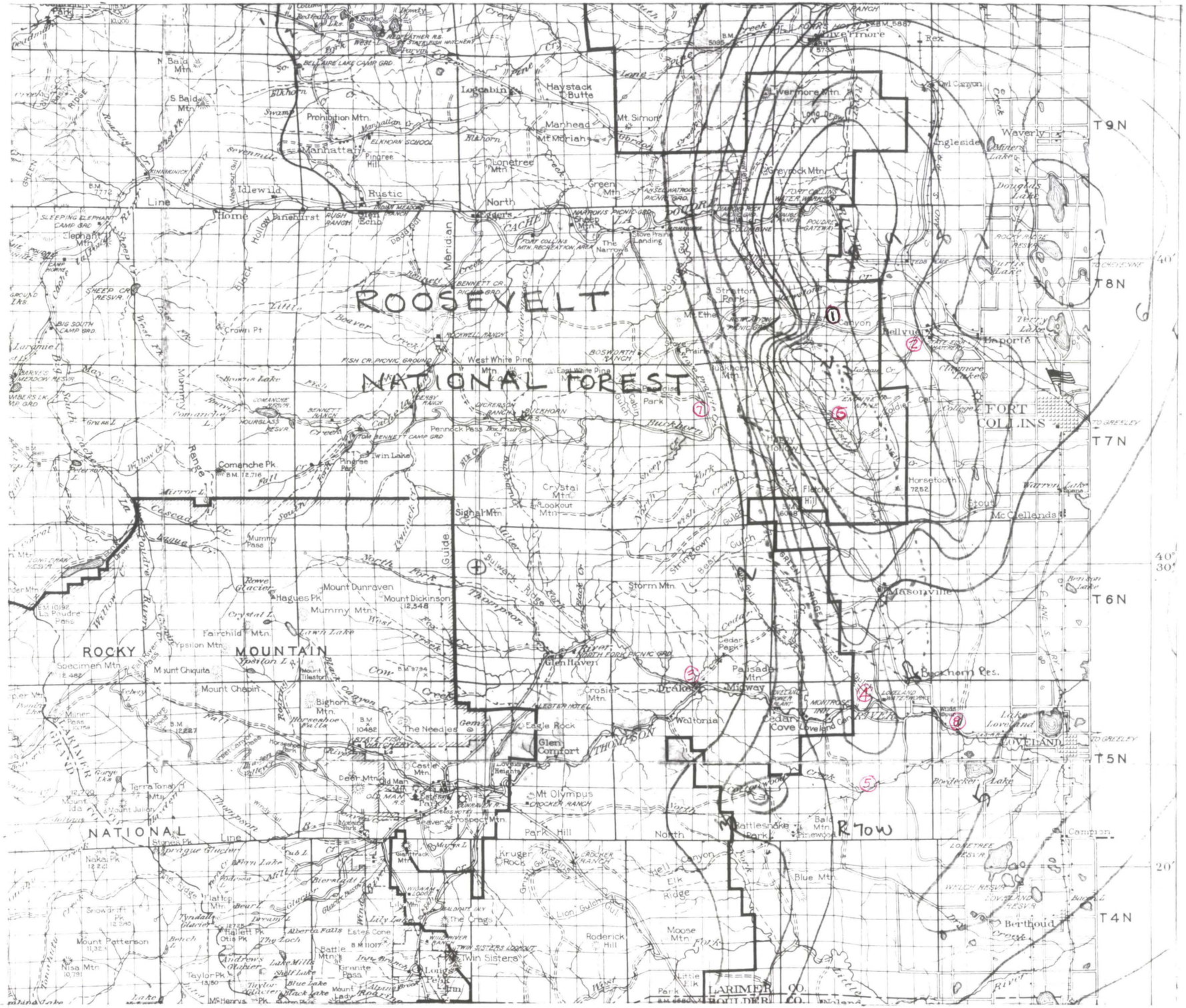
ISOHYETAL MAP

STORM OF AUGUST 2, 3, 1951

NORTH CENTRAL COLORADO

U.S.B.R. – S.P.R.D. – DENVER, COLORADO

SCALE OF MILES



Index

1. Rist Canyon
2. Labeau Creek
3. Cedar Creek
4. Julzer Gulch
5. Cottonwood Creek
6. Redstone Creek
7. Stove Prairie Creek
8. Big Thompson R. at Lime Plant

ISOHYETAL MAP
STORM OF AUG. 2-3, 1951
BUCKHORN CREEK AREA AND VICINITY

Map 2

Table 1.--Rainfall depths in inches from recording rain gages during the storm of August 2-3, 1951

Date	Hour	Amount Inches	Accumulated Inches	Date	Hour	Amount Inches	Accumulated Inches
2	8 p.m.	1.25	1.25	2	to 4 p.m.	.14	.14
	9	.17	1.42		7	.01	.15
	10	.15	1.57		8	.02	.17
	11	.23	1.80		11	.12	.29
	12	.17	1.97		12	.13	.42
3	1 a.m.	.23	2.20	3	1 a.m.	.85	1.27
	2	.20	2.40		2	.44	1.71
	3	.25	2.65		3	.45	2.16
	4	.18	2.83		4	.16	2.32
	5	.02	2.85		5	.13	2.45
	6	.02	2.87		6	.02	2.47
	7	.08	2.95		7	.01	2.48
	8	.05	2.00		8	.02	2.50
	9	.05	3.05		9	.01	2.51
	10	-	-		10	-	-
	11	-	-		11	.01	2.52
	12	-	-		12	-	-
	1 p.m.	.01	3.06		1 p.m.	-	-
	2	-	-		2	-	-
	3	-	-		3	-	-
	4	-	-		4	-	-
	5	-	-		5	-	-
	6	-	-		6	.85	3.37
	7	-	-		7	1.66	5.03
	8	.36	3.42		8	-	-
	9	1.62	5.04		9	.03	5.06
	10	.97	6.01		10	-	-
	11	.05	6.06		11	-	-

ranchers in the Redstone area estimated that this rain was from 4 to 6 inches with intensities higher than the one of August 2. The storm in the mountains apparently occurred from 6:30 to 9:30 p.m., while in the valley areas at Fort Collins the intense storm was from between 7:00 and 10:00 p.m. The maximum 15-minute rainfall depth at Fort Collins was 1.10 inches, beginning at 8:40 p.m. with an intensity of 4.40 inches per hour. The maximum 15-minute intensity in the mountain area was probably from 6 to 9 inches per hour.

The total rainfall at Fort Collins during the period of August 2 to 3 was 6.07 inches in 27 hours. Other rains of record at Fort Collins are the storm of September 2 to 3, 1938 when 4.68 inches fell in 48 hours, September 20 to 21, 1922 when 6.22 inches fell in 48 hours, and June 19, 1899 when 1.74 inches fell in 40 minutes. The rainfall depths and pattern of the storm in the mountains as shown on Map 1 are estimated from a bucket survey of the storm area. There are no official Weather Bureau gages in this area.

Flood Discharges

The streams carried heavier than usual flows as a result of the August 2 rains. The August 3 rain caused flash flood runoff with a rapid rise. The peak fell off rapidly but heavy flow was maintained for several days thereafter. The streams still carried far above normal flow 10 days later. Measurements of peak flows were taken at the following points.

Cache La Poudre at canyon mouth - 5,600 c.f.s.
Cache La Poudre at Fort Collins - 8,000 c.f.s.
Buckhorn Creek near Masonville - 14,600 c.f.s.

The hydrograph of Buckhorn Creek at Masonville is shown on Chart 1. Consideration of the rainfall amounts and flood discharges on August 2 and 3 indicates that the August 2 rain on Buckhorn Creek had a volume of about 9,800 acre feet with a resulting runoff of some 700 acre feet, with a peak discharge of 1,150 c.f.s. The rain of August 3 over the same area had a volume of 10,800 acre feet, a runoff of 2,500 acre feet, with a peak discharge of 14,600 c.f.s. Considering that the rainfall amounts for each of the two storms were about the same, floods from the second storm had 4 times the volume and 21 times the peak of the first. Estimates of peak flow were made by Forest Service personnel on the following streams:

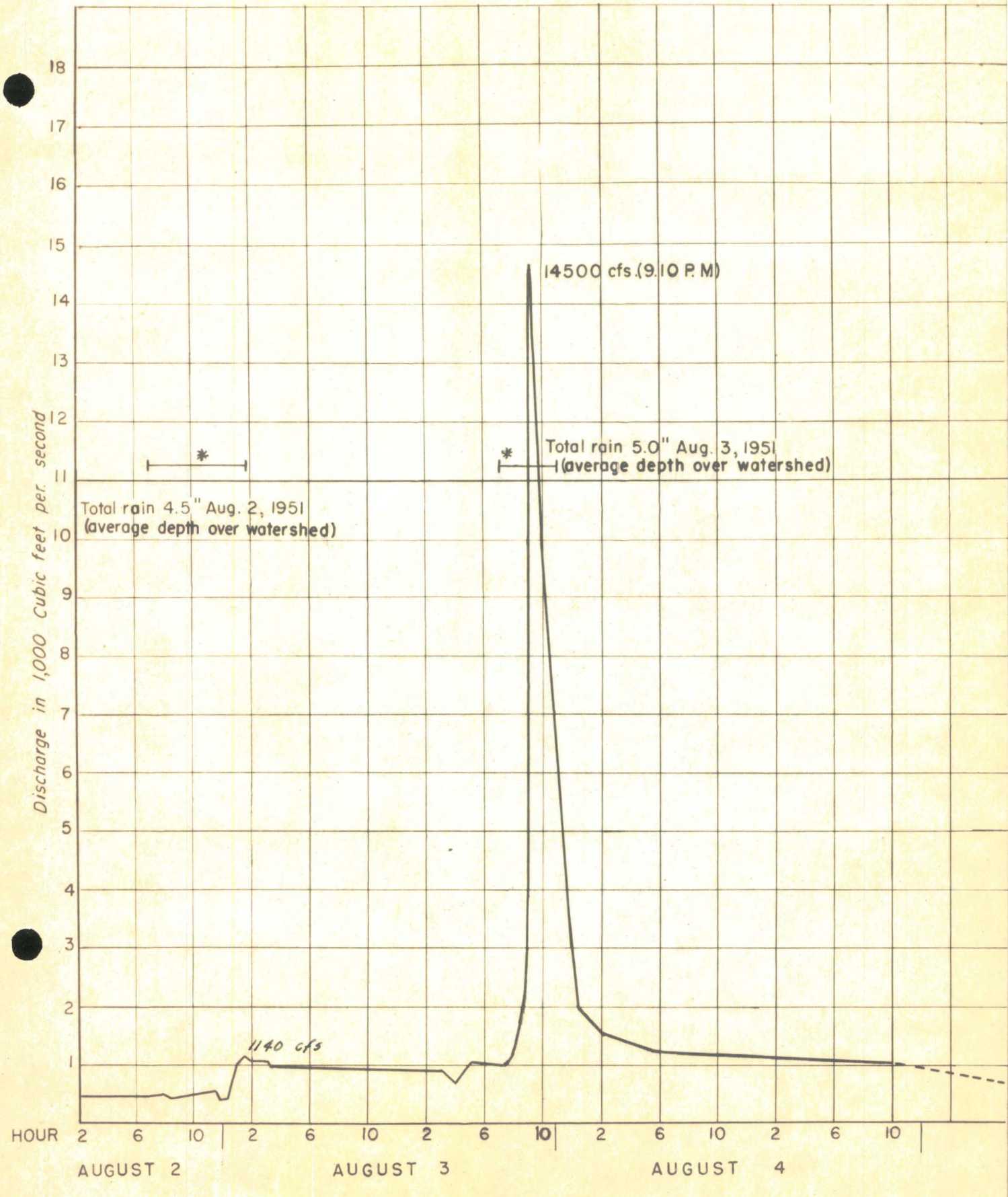
Name	Area Square Miles	Peak discharge c.f.s.
Rist Canyon	7	2,500
Labeau Creek at Bellvue	*	4,000
Cedar Creek at Big Thompson	7	2,000
Sulzer Gulch at Big Thompson	*	2,500
Cottonwood Creek	*	1,500
Redstone Creek at Masonville	22	8,000 - 9,000
Buckhorn Creek at Masonville	19	4,000 - 5,000
Buckhorn Creek at the Big Thompson	*	17,000
Big Thompson River at lime plant	*	20,000

* Area not available--areas listed are areas contributing to flood runoff.

The heavy rains covered only a part of the Buckhorn Creek drainage. The area above Stove Prairie Creek contributed very little water. There are 134 square miles of drainage area above Buckhorn

HYDROGRAPH BUCKHORN CREEK NEAR MASONVILLE COLORADO

Storm of August 2 and 3, 1951



* Time period when rain fell

CHART 1

Dam of which about 112 square miles are in the Roosevelt National Forest. Excessive runoff came from some 32 square miles in the Roosevelt National Forest and from about 20 square miles outside the forest boundary. The peak discharge of Buckhorn Creek at Masonville was 14,500 cubic feet per second and occurred at 9:10 p.m. on August 3. This is the maximum recorded peak discharge for this watershed. The Buckhorn Dam apparently failed sometime after 9:10 p.m. and before 10:00 p.m. when four persons were drowned on the Big Thompson highway at the mouth of Buckhorn Creek. The Buckhorn Reservoir has an active capacity of about 200 to 300 acre feet below spillway level. The reservoir was apparently full from the high water on August 2. The dam failed by overtopping due to insufficient spillway capacity. The resulting flood downstream had a wall of water estimated from 6 to 10 feet high. The flow of the Big Thompson River at Cedar Cove , some 4 miles above the mouth of the Buckhorn, was about normal at 300 c.f.s., while at Little Dam about 2 miles downstream the flow was about 2,500 c.f.s. The addition of this flow to the discharge from Buckhorn Creek resulted in a peak of about 20,000 c.f.s. on the Big Thompson near the lime plant. The Cedar Creek, at Cedar Cove (tributary to the Big Thompson River), had no flood water discharge on the night of August 2 or morning of August 3. On the evening of August 3, however, two peaks came down, one about 6:00 p.m. and the other about 10:00 p.m. Peak flow was estimated from high water marks to be about 2,000 c.f.s. from 7 square miles of contributing area.

Sedimentation

While no sedimentation rates were obtained as a result of this flood the sediment rate of Buckhorn Reservoir prior to its failure has been obtained. Located in Section 36 T 6 N, R. 70 W. near Masonville, Colorado, it was constructed by a private irrigation company in 1907. The reservoir, with an original capacity of 1,190 acre feet, was formed by an earth dam some 600 feet long with a maximum earth fill of about 60 feet high. The drainage area above the dam is 130 square miles of foothill country. A capacity survey of the reservoir made in 1925 indicated an active capacity of 625 acre feet. This indicates a sediment contribution rate of .25 acre feet per square mile per year.

Flood Damages

A complete report on flood damages is not available from the Corps of Engineers. A brief description of damages is included to indicate the extent of flooding.

Aden H. Webb, Bellvue, drowned in Labeau Creek when his house was swept away.

George Post and Mrs. Post, Bellvue, were drowned when they stepped out of their house into flood waters of Labeau Creek.

Mrs. Sally Johnson, Beverly, Mabel, and Mildred Johnson, all of Denver, were drowned when their automobile was swept from the highway by the Big Thompson River.

Approximately 20 miles of county roads were damaged to the point where reconstruction is necessary. About 30 bridges were taken out. Many more miles of county and state roads need repair. Several dwellings were washed away and others damaged. Although no detailed damage

estimates were made by us, the following are very rough guesses as to damage:

County and private roads	$200,000
State highways	20,000
Bureau of Reclamation canals	40,000
Dwellings and other buildings	200,000
Buckhorn Dam	50,000
Crops	100,000
Fences	10,000
Miscellaneous property	100,000
Total	$720,000

Principal areas of damage as given by the DENVER POST on August 4 are:

1. Loveland - A thousand people were displaced by a 6-foot wall of water which hit the west end of town. The flood water inundated business establishments, farms, homes, and broke several irrigation ditches.

2. Longmont - 700 persons were displaced along the south St. Vrain Creek with the Alkaline Creek Dam washed out.

3. Lyons - The St. Vrain Creek displaced some 400 people.

4. Boulder - Floods from Boulder Creek washed out six highway bridges and high water breached irrigation ditches resulting in the flooding of residential and business areas.

5. Fort Collins - The Cache La Poudre River rose to 8,000 c.f.s. Saturday, August 4 from a flow of 750 c.f.s. August 2, flooding some property in the low-lying areas of Fort Collins. The main damage at Fort Collins was to the Agricultural College when heavy rains and broken irrigation ditches flooded the College property resulting in estimated damage of about $250,000. Newspaper clippings at the end of the report indicate the extent and severity of damages.

Watershed Condition

Following the earlier reconnaissance a more detailed field examination of the watershed area was made by the Roosevelt National Forest between August 4 and August 13. This examination revealed that about 95 percent of the area is covered in varying degrees by native vegetation as is shown on Map 3.

Within the intense storm area the following generalized factors are pertinent to the flood problem:

Ownership

National Forest - 25 percent
Privately owned - 75 percent

Vegetation type (estimate)

Heavy PP - DF timber	- 50 percent
Ponderosa pine-grass-brush	- 40 percent
	- 10 percent

Condition of ground cover (estimate)

Heavy timber - nearly all good to excellent		
PP-grass-brush	- 60 percent	poor
	- 30 "	fair
	- 10 "	good
Brush and grassland	- 50 "	poor
	- 35 "	fair
	- 15 "	good

Map 4 gives generalized plant cover and erosion classes for the area. Map 5 indicates cutover areas, Map 6 shows land ownership within the Roosevelt National Forest.

Observations were made in Section 12, T. 7 N., R. 71 W., 6th P.M. on August 13. At the time of examination this was believed to be storm center. Although intensities are not known, they were

Roosevelt Nat'l Forest

POUDRE WORKING CIRCLE
Generalized Type Map
And
Road Development Plan

Legend

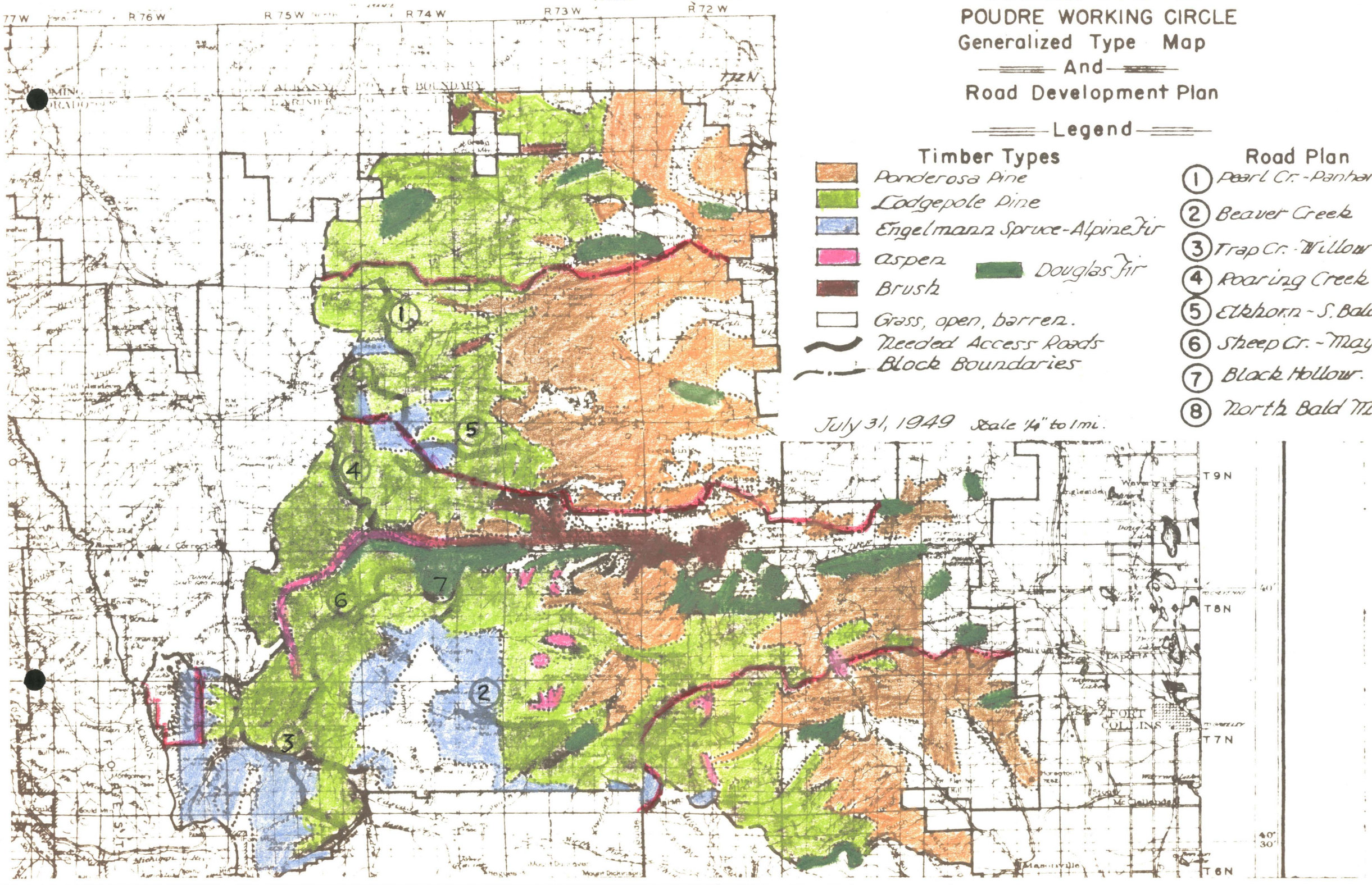
Timber Types

- Ponderosa Pine
- Lodgepole Pine
- Engelmann Spruce-Alpine Fir
- Aspen
- Douglas Fir
- Brush
- Grass, open, barren.
- Needed Access Roads
- Block Boundaries

Road Plan

1. Pearl Cr. - Panhandle
2. Beaver Creek
3. Trap Cr. - Willow Cr.
4. Roaring Creek
5. Elkhorn - S. Bald Mtn.
6. Sheep Cr. - May Cr
7. Black Hollow.
8. North Bald Mtn.

July 31, 1949 Scale 1/4" to 1mi.



U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INTERMOUNTAIN FOREST & RANGE EXPERIMENT STATION
OGDEN, UTAH

FLOOD CONTROL SURVEY

UPPER SOUTH PLATTE RIVER WATERSHED
(ABOVE KERSEY, COLORADO)

PLANT COVER - EROSION MAP

SUBMITTED O.C.O. 1-18-49 DATE		APPROVED H.L.L. 1-18-49 DATE	
COMPILED O.C.O. - G.W.C. TRACED B.F.I. CHECKED G.W.C.	MAP NO.		APPENDIX NO.

LOCATION MAP

100 50 0 50 100 200 MILES
SCALE

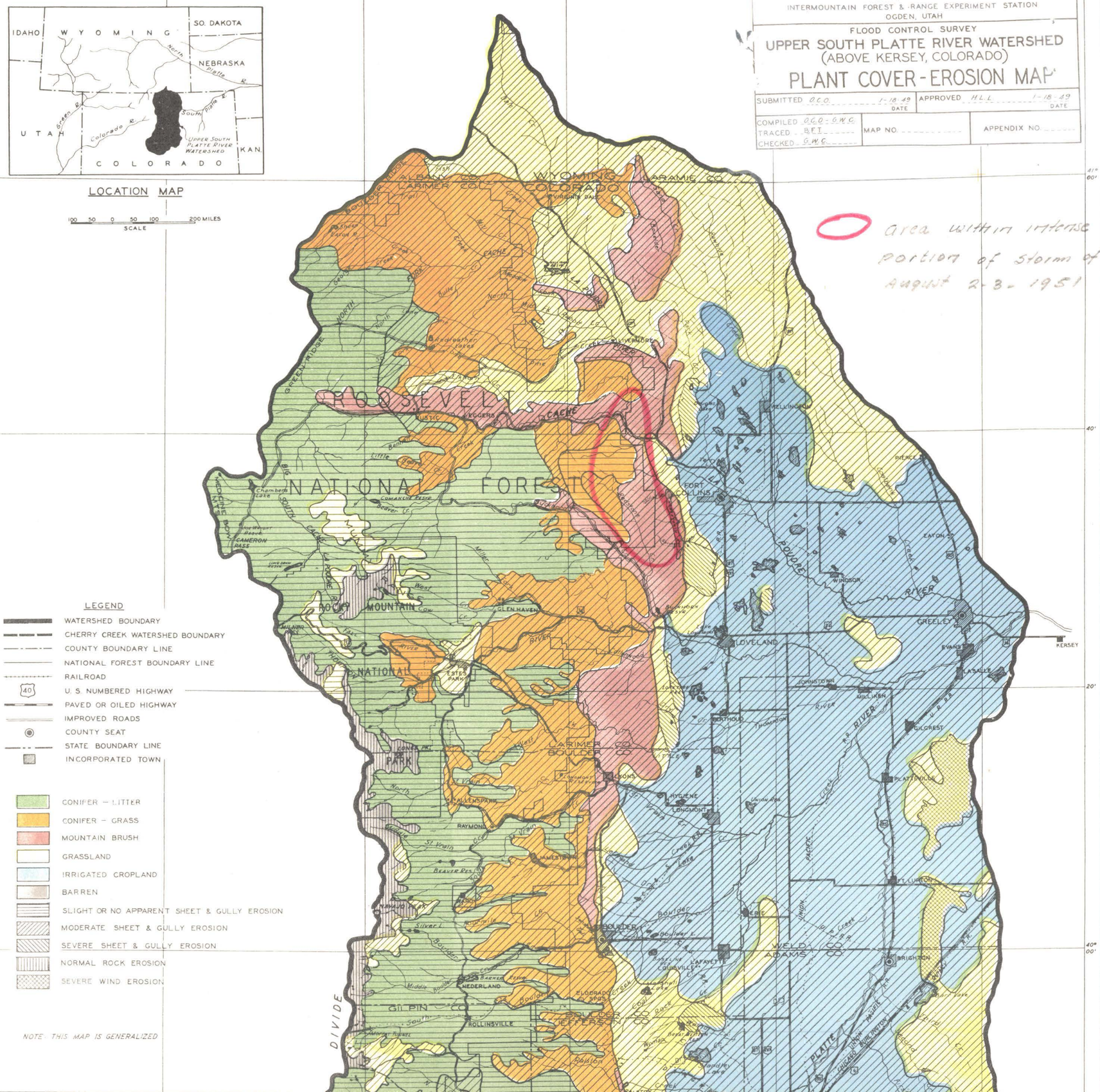
Area within intense portion of storm of August 2-3-1951

LEGEND

- WATERSHED BOUNDARY
- CHERRY CREEK WATERSHED BOUNDARY
- COUNTY BOUNDARY LINE
- NATIONAL FOREST BOUNDARY LINE
- RAILROAD
- (40) U. S. NUMBERED HIGHWAY
- PAVED OR OILED HIGHWAY
- IMPROVED ROADS
- COUNTY SEAT
- STATE BOUNDARY LINE
- INCORPORATED TOWN

- CONIFER – LITTER
- CONIFER – GRASS
- MOUNTAIN BRUSH
- GRASSLAND
- IRRIGATED CROPLAND
- BARREN
- SLIGHT OR NO APPARENT SHEET & GULLY EROSION
- MODERATE SHEET & GULLY EROSION
- SEVERE SHEET & GULLY EROSION
- NORMAL ROCK EROSION
- SEVERE WIND EROSION

NOTE: THIS MAP IS GENERALIZED



R 2
Roosevelt Nat'l Forest, Colorado

POUDRE WORKING CIRCLE
CUT-OVER MAP

Legend

Cut-over – Nat'l Forest Land

Clean-burn

July 31, 1949

R 76 W
R 75 W
R 74 W
R 73 W
R 72 W
R 71 W
R 70 W
R 69 W
T.12 N.
T11N
T10N
T9N
T8N
T7N
T6N
41° 00'
40° 30'
ALBANY CO.
BOUNDARY LINE
LARIMER CO.
BOULDER CO.
GRAND CO.
JACKSON CO.
COLORADO
WYOMING
FORT COLLINS
Old Glacier
Bald Mtn
Bald Mtn
Haystack Butte
Meadow
Overtree
Glacier Mtn
Rustic
Meridian
Comanche Pk
Mount Duncan
Mount Richthofen
Chambers Lake
Clark Mtn
Gould
Masonville
McGillcuddy
Fletcher Hill
Signal Mtn
Long Draw
Dale Creek
Crystal Creek
Cache la Poudre
Big Creek
Deadman Gulch
Bull Rock
Cow Rock
Mill
Middle
Long
Dry
Sand Creek
Rabbit Ear Creek
Elkhorn School
Prospect Mtn
Mountain Park
Cabin
Dunraven
Thatcher
Pingree Park
Stove Prairie
Stove Prairie School
Buckhorn Mtn
Fall River
Fall River Pass
Milner Pass
Trail Ridge
Poudre Lake
Poudre Pass
Poudre Park
Poudre Canyon
Poudre River
Big Thompson
Big Thompson River
Big Thompson Canyon
Estes Park
Estes
Loveland
Longs Peak
Twin Sisters
Twin Sisters Peak
Lyons
Old Stage Road
Old Stage
Old Stage Canyon
Old Stage Gulch
Old Stage Ridge
Old Stage Hill
Old Stage Mtn
Old Stage Creek
Old Stage Pass
Old Stage Trail
Old Stage Road
Old Stage
Old Stage Canyon
Old Stage Gulch
Old Stage Ridge
Old Stage Hill
Old Stage Mtn
Old Stage Creek
Old Stage Pass
Old Stage Trail

Forest Service

Roosevelt Nat'l Forest, Colorado

POUDRE WORKING CIRCLE

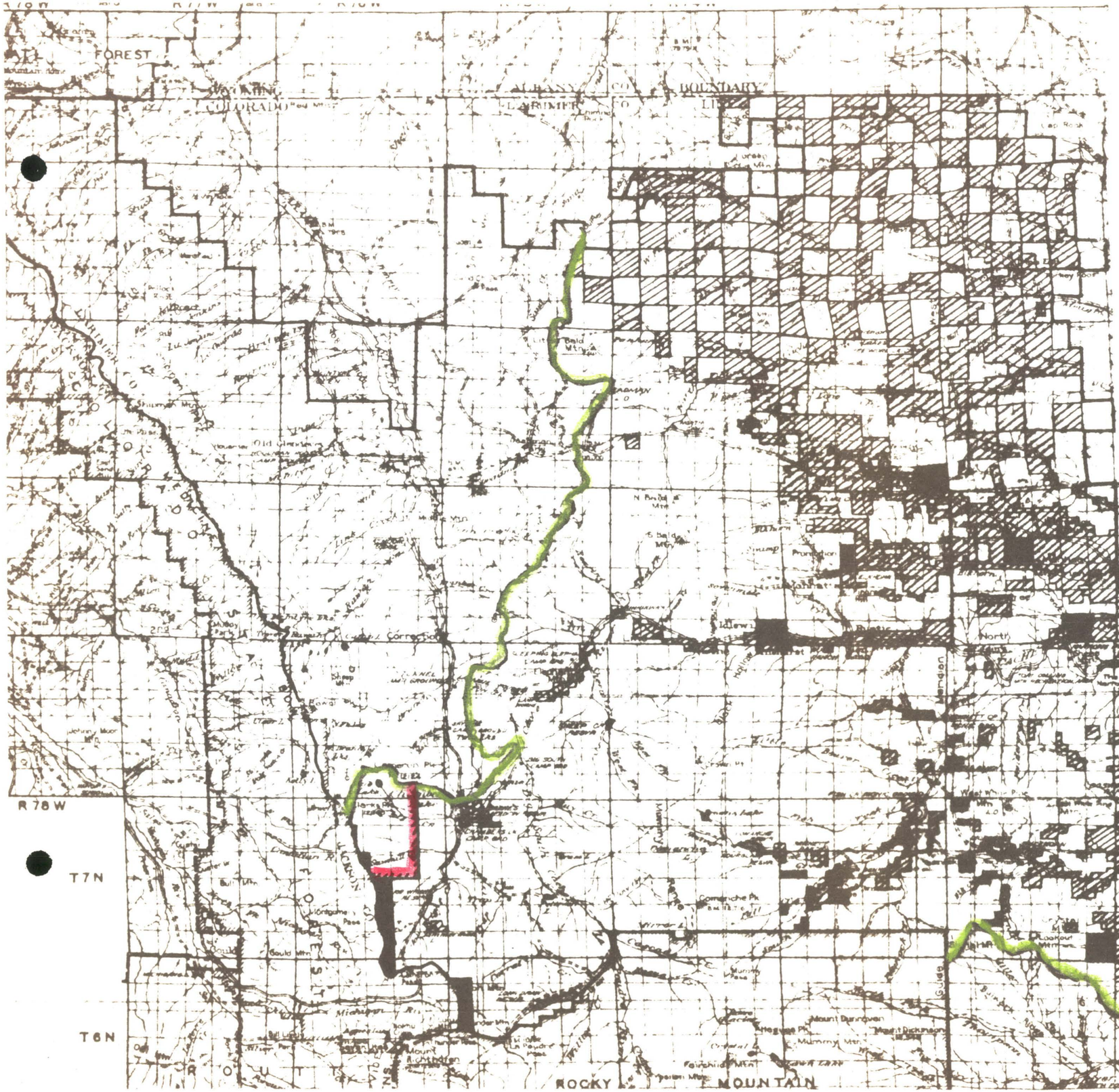
Ownership Map

Scale ¼" to 1 mile

Legend

- Private Land
- State Land
- Rawah Wilderness Area
- Working Circle Boundary

July 31, 1949 J.N.L. 3-2-50



undoubtedly high. There are no official measurements of total rainfall. It is estimated to be 8 inches in the August 3 storm for the peak area. Indications are that there was also some hail along with the rain.

Fortunately there was considerable variation in the ground cover thus giving a good basis for comparing the effectiveness of cover on runoff and erosion. Four types of cover conditions in the heaviest rain area were examined. These were:

Dense Douglas-fir timber in excellent condition.
Ponderosa pine grassland in poor condition.
Ponderosa pine grassland in good condition.
Ponderosa pine grassland in excellent condition.

Photo #1.--Dense Douglas-fir timberland, found primarily on north slopes. (Tem. #483)

Photo #2.--Shows poor condition. PP-grassland. Heavy runoff and erosion evident, even though slope was very short. (Temp. #484)

Photo #3.--Close-up of ground cover in poor PP-grassland. Grass is primarily blue gramma. Very little litter. Runoff very heavy. (Temp. #489)

The ponderosa pine grassland in poor condition as shown in photos 2 and 3, showed evidence of very heavy runoff and heavy surface erosion over all the slopes.

Photo #4.--PP grassland in good condition. Some runoff, but very little erosion. (Temp. #490)

Photo #5.--Small drainage way in good condition PP grassland. Shows some runoff but no cutting. (Temp. #491)

The ponderosa pine grassland in good condition, as shown in photos 4 and 5, showed considerably less runoff than that in poor condition. There was very little erosion. Cheatgrass in the steeper areas has supplied considerable litter, and evidently raised the infiltration capacity noticeably over nearly bare areas.

Photo #6.--PP grassland in excellent condition. No evidence of runoff. (Temp. #493)

This land provided a solid ground cover of bunchgrasses, primarily Andropogon scoparius. There was no evidence of runoff from this small area of land.

Summary

A relatively small area produced a large portion of the runoff that went down Redstone and Buckhorn Creeks.

The runoff from within this small area came primarily from about 40 percent of the surface area. The condition of the ground cover was a primary factor influencing the amount of runoff. This is also true of sheet and gully erosion. In fact, most of the runoff and erosion came from the ponderosa pine-grassland in poor condition. These are primarily on south slopes in granitic and schist soils.

Management of these ponderosa pine-grassland areas is very important from the standpoint of watershed management. Soils are shallow, and it is difficult for such sites to produce adequate cover under present use to properly protect the site during such heavy storms. As a result plant condition is poor, and utilization is heavy. A fence separates this allotment from a block of private land which is in much better condition. From the fence line large differences in runoff and particularly in erosion are plainly noticeable. It was estimated that runoff from the area in poor condition was from three to four times that produced by adjacent areas in good to excellent condition.

The storm also emphasized the fact that the management of certain areas within areas where intense and heavy storms frequently occur is very important, even though they are only a small proportion of the area as a whole.

Field observations and conclusions concerning the runoff and erosion from this flood as well as the Spring Canyon flood of May 30, 1948 near Fort Collins and the Tucker Canyon flood of June 7, 1948 near Golden, Colorado were compared. In each case evidence on the ground indicated that where there were optimum cover conditions very little excessive erosion occurred. In the case of flood runoff, however, even where optimum cover conditions were present storm rainfall as experienced in all these has exceeded infiltration capacities and flood peaks of damage causing proportions have been produced. At the same time cover conditions below optimum have accelerated the runoff and heightened flood peaks.

It is therefore evident that in order to obtain the required flood reductions in this area it will be necessary to install flood detention dams and channel protection works in addition to improved land management and minor erosion control practices.

PHOTOGRAPHS OF FLOOD DAMAGE

Photo #7.--View of dam break in Buckhorn Reservoir. (Temp. #502)

Photo #8.--Sediment in Buckhorn Reservoir from past storms. (Temp. #523)

Photo #9.--Sediment deposited by flood in Big Thompson River Valley. (Temp. #500)

Photo #10.--Flood damage in Big Thompson River Valley, taken August 4. (Temp. #499).

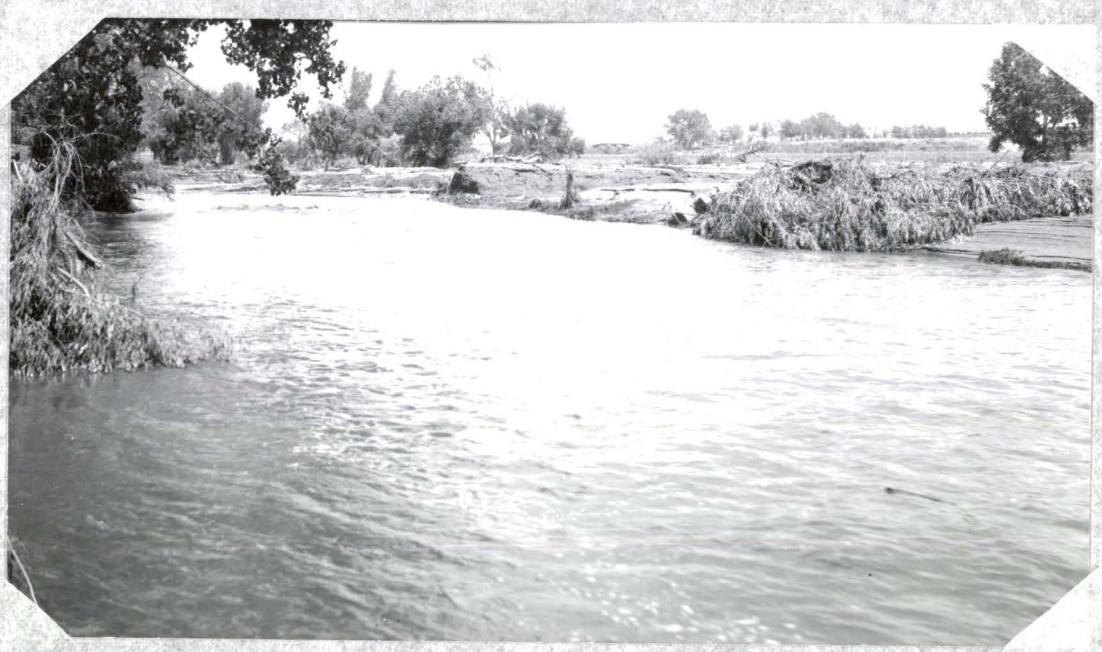


Photo #11.--Flood damage in Big Thompson River Valley, taken August 4. (Temp. #498)

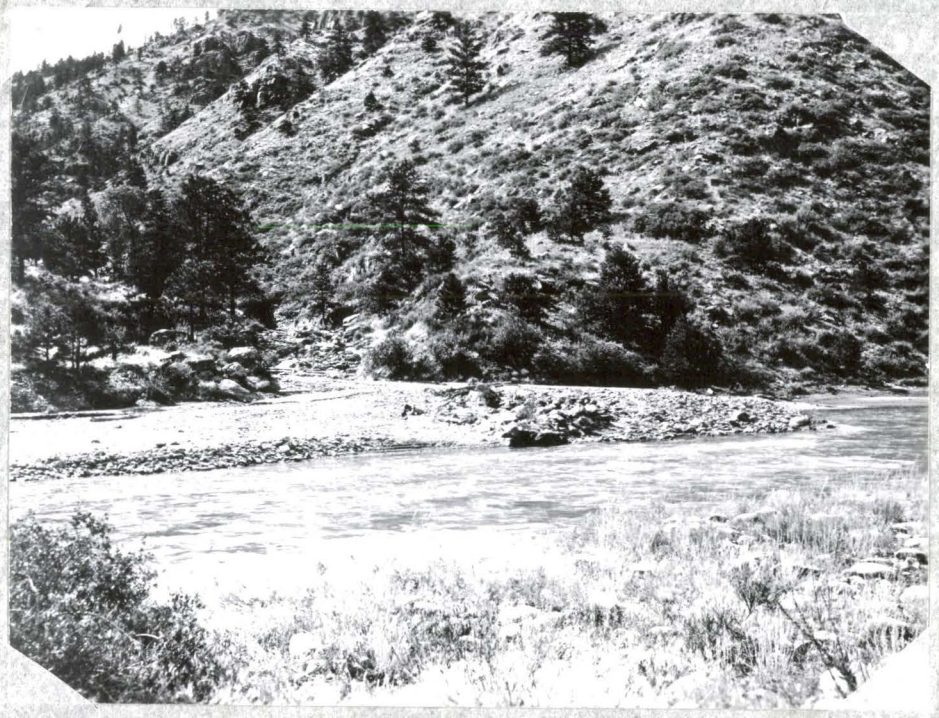


Photo #12.--Debris deposited in the channel of the Cache La Poudre River from a small tributary as a result of heavy rains August 3, 1951. Located in Sec. 9, T. 8 N., R. 70 W just inside the boundary of the Roosevelt National Forest.

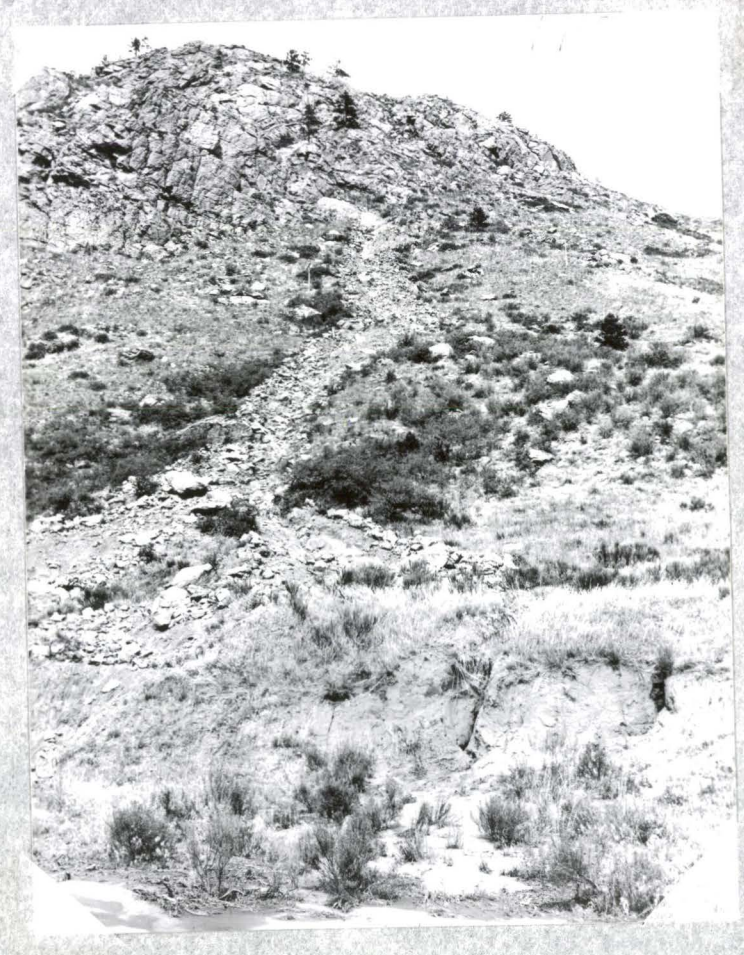


Photo #13.--One of several debris flows caused by torrential rains of August 2 and 3, 1951. Excess water here largely from bare rocks. Located in Cache La Poudre River canyon in Roosevelt National Forest, Colorado.

Photo #14.--A small drainage way with well vegetated slopes located on private land on the Langer Ranch at the south end of Rattlesnake Park in Sec. 1, T. 4 N., R. 71 W. This area was in the edge of the zone of the heavy rains of August 2-3, 1951. About 3 inches of rain fell in this area.

SOME TYPICAL NEWSPAPER ARTICLES

Denver Post

3,000 Routed By Flash Floods; Two Dams Burst

Aug.4, 1951

See story on page 1 also.

Nearly 3,000 Coloradans in a half dozen communities were driven from their homes Friday night by flash floods that came crashing out of the Rocky mountains.

Damage was expected to run into the hundreds of thousands of dollars. Highway bridges were washed out, thousands of basements were flooded and farms damaged by the surging water.

Two earthen dams were burst by the pounding waters. One, on Buckhorn creek, sent a 10-foot wall of water down the Big Thompson canyon.

1,000 AT LOVELAND.

Here is a town-by-town report of damage:

LOVELAND — Approximately 1,000 persons driven from their homes after a six-foot wall of water hit the west end of town. At least four houses swept from foundations. A break in the Lake Loveland irrigation ditch system flooded two to three square miles in southern Loveland. Fair grounds under water.

LONGMONT—About 700 persons evacuated along South St. Vrain. City water supply line washed out. Extensive damage to homes and farms when dam on Alkali lake six miles southwest of town went out.

LYONS—Total damage estimated at $30,000. East side of town flooded by St. Vrain river; 400 homes flooded; about ten families evacuated. Water knee deep along main street. All street lights out.

BOULDER—Water in many basements in east and north sections of town, mostly from overflowing irrigation ditches. Six bridges washed out on county road to Longmont. Telephone and power service cut off in many parts of city.

FORT COLLINS—Cache La Poudre river out of its banks, flooding basements in east and north part of city; Colorado A. & M. campus flooded, the "oval" completely covered with water; five feet of water in the heating plant. Some residents of Buckingham and Andersonville evacuated.

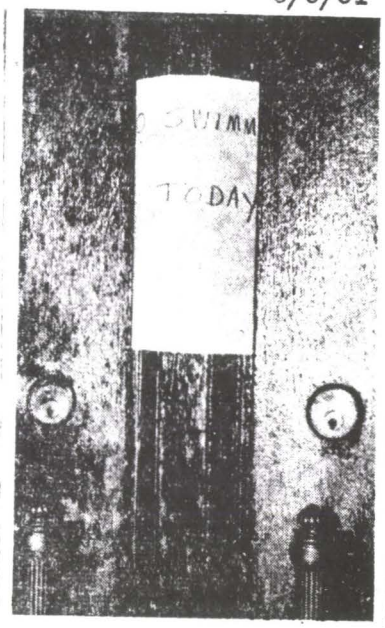
WATER IN THREE SURGES.

The water came down the Big Thompson canyon in three surges, with Loveland probably the hardest hit of all the communities. But floods in the other canyons were almost as bad.

Cloudbursts, starting around 4:30 p. m. Friday and continuing intermittently until late in the evening, produced the floods.

The storms followed one early Thursday that drenched Denver, flooded basements and did considerable damage to homes and streets.

Fort Collins Coloradoan
8/5/51



NO JOKE, REALLY—This sign, "No Swimming Today," was found tucked in the door of the flooded A & M college gymnasium early Saturday by the Coloradoan photographer, who used hip boots to get to it.

Denver Post --- 8/4/51

10 Counties Designated Disaster Area

By Associated Press.

Ten counties in southwestern Colorado have been declared a "disaster area" for emergency drouth freight rates by Governor Thornton.

He flew over the area Friday before issuing a proclamation at the request of Agriculture Commissioner Paul W. Swisher.

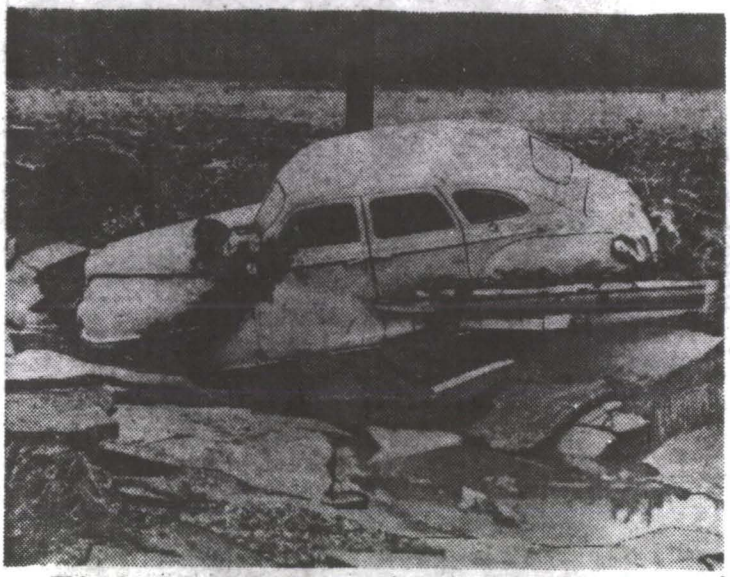
The counties are La Plata, Dolores, Montezuma, Archuleta, Saguache, Conejos, Alamosa, Costilla, Mineral and Rio Grande.

The situation is critical, the governor said, and "great patches of burned out meadows were visible from the air."

The emergency designation will permit livestock to be shipped from the area at reduced rates. Stock feed also may be shipped in at lower figures.

Sunday, Aug. 5, 1951, Denver, Colo. —ROCKY MOUNTAIN NEWS— 3

Cloudbursts Take 7 Lives



This abandoned auto was swept off of U. S. Highway 34 two miles west of Loveland by Friday night's flash flood. The car, mud-caked and water-soaked, ended up wedged against a power pole.

By PASQUALE MARRANZINO

Rocky Mountain News Writer

A series of savage cloudbursts in the state's breadbasket area Friday night turned dashing streams into deadly torrents and brought sudden death to seven persons.

The storms dropped in sheets from sodden skies and sent flash floods roaring down the choked canons of the foothills from Boulder to Fort Collins, bringing destruction which was estimated at more than a million dollars.

The swirling waters filled expansive Buckhorn Reservoir six miles west of Loveland to overflowing and then ripped away its earthen face to send down a wet wall of doom which wiped out four of five members of a Denver family and wreaked heavy damage on the Loveland area.

Dead were:

Mrs. Sally Johnson, 40, of 1961 S. Grant st., her daughter, **Beverly**, 15, and twin daughters, **Mabel** and **Mildred, 14.**

The head of the family, Harold Johnson, 42, miraculously escaped death in the torrent.

Near Fort Collins, the rampaging Cache la Poudre River ran over its banks and took the lives of three other persons.

The were identified as **George Post**, 40, and his wife, **Annabelle**, 40, who were swept to death from the porch of their ranch home at Bellvue, eight miles west of Fort Collins, and **Aden E. Webb**, 86, also of Bellvue, who slipped from the roof of his floating cabin into the swirling river.

SHEETS OF HEAVY RAIN PELT EASTERN SLOPES

The massive thunderhead which unleashed the destruction and death moved systematically from Boulder to Lyons, to Longmont, to Fort Collins and then eastward with diminishing fury.

Sheets of heavy rain pelted the eastern slopes of the Continental Divide turning dry creek beds, small brooks and dashing streams into snarling rivers of murky water. The water ripped out numerous mountain and farm bridges, swept away trees, inundated rich farm lands and uprooted many homes in its pell-mell dash to the east.

More than 1000 persons in the storm-wracked area were left homeless and suffered heavy personal damage.

Foothills roads were ripped apart by the rampaging streams and mountain highways were clogged or made hazardous by rock slides caused by the deluge.

HIGHWAY DEPARTMENT SEEKS TO CLEAR ROADS

The State Highway Department early yesterday threw battalions of emergency construction crews in an an attempt to clear or open vital tourist arteries leading into Rocky Mountain National Park.

The destructive waters hit hardest at Loveland due to the break in Buckhorn Reservoir. The wall of water swept houses downstream, ripped up miles of roadway and a railway spur linking Loveland with a plaster plant three miles west of the city. The force of the water tore away huge trees, telephone and power lines and miles of fence. It bent rails and tossed a dozen automobiles about as if they were flotsam.

In one of the automobiles was the ill-fated Johnson family which was trapped in the torrent as it made its way toward Big Thompson Canon for a weekend vacation.

Mr. Johnson attempted to transfer his family from the inside of his trapped automobile to the top but was swept away. He miraculously managed to cling to a tree from which he was rescued near dawn.

Dale Bake, 17, of Big Thompson Canon also was trapped in his automobile. He quickly climbed from it to the roof and when the automobile rolled over in the torrent dived onto a floating bale of hay and rode it more than a mile down the seething, roaring river. The bale smashed into a tree and Dale climbed it to safety. He was rescued after spending more than four hours in the tree.

Other hazardous experiences with flood waters poured in as the waters receded and the hundreds of persons affected by the tragedy reported to authorities and friends.

In Longmont, the placid St. Vrain River became a monster and churned down the fertile valley to wreak destruction and inundate Longmont lowlands.

The waters cut U. S. 87-287, connecting Longmont and Denver, for 10 hours. Waters from the Big Thompson cut U. S. 87-287 between Longmont and Loveland and stretched a ribbon of swirling water a quarter-mile wide on the southern approaches to the city.

BRIDGES WASHED OUT WITH 12.7 FOOT CREST

The excess waters poured into the South Platte River near Fort Morgan and washed out four bridges with a 12.7 foot crest. The normal crest is 2.9.

Volunteers from Loveland's fire and police departments, directed by Sheriff Ray Barger of Larimer County and Deputy Sheriff Roy Bonsall, made up search parties which recovered the bodies of the Johnson family.

A citizen's crew of 50 men stood by the south dike of huge Loveland Lake to ward off overflow when the crest of the Buckhorn Reservoir hit the lake. The lake borders Loveland on the northwest.

Fort Collins Coloradoan - 8/5/51

A&M Campus, Part Of City Swamped

Larimer county's worst floods in many years took the lives of at least seven persons Friday evening and caused damage estimated at close to $1,000,000.

Three persons were drowned at Bellvue eight miles west of here. They were Aden E. Webb, 86, George Post, 50, and his wife, Mrs. Annabelle Post, 44, all of the Bellvue area.

The wife and three daughters of a Denver man, Harold Johnson, were drowned when their automobile was swept off highway 34 about 4½ miles west of Loveland by a huge wave of water about 10 p. m. Friday.

The victims were Mrs. Sally Johnson, 44, Miss Beverly Johnson, 16, and Mildred and Mabel Johnson, 14-year-old twins.

An estimated $270,000 damage occurred at Colorado A & M college here. (See story on page 4). Great damage to highways, communication and power lines and private property occurred throughout the county, with many buildings and basements flooded.

Near Cloudburst

The floods stemmed from a near-cloudburst which struck the area about 7:30 p.m. Friday and continued almost without interruption to about 10 p.m. Almost three inches of rain fell here during the storm, which was accompanied by a violent electric storm.

In the foothills west of Fort Collins and Loveland, the waters quickly formed into flash floods which swelled the county's larger rivers and creeks as they merged into them. Within an hour after the storm started, water was running over highway 287 northwest of here and the Big Thompson canyon highway. Highway 14 in Poudre canyon was blocked by a rock slide 16½ miles west of here.

House Washed Away

Mr. Webb was drowned when the small house he lived in south of the Bellvue store was washed into Dry creek between 6:30 and 8 p.m. His body was found about a half-mile downstream about 11 p.m. by Clifton Tamlin, G. R. Cole and others. Coroner Harold A. Warren reported.

Mr. and Mrs. Post apparently drowned about 8:30 p.m. at their home in Bow gulch, about 1½ miles west of Bellvue. Mrs. Post opened the door when a wall of water hit the house and stepped out into about five feet of water. She was swept away and her husband drowned when he tried to rescue her.

Joe Vigil, Mr. Post's hired man, stayed in the house, asleep in the kitchen. He was discovered unharmed Saturday morning by Ray Pedigo, who afterward reported the Posts missing.

Found in Field

Mrs. Post's body went with the Dry creek overflow into the Highland ditch, then through a break in the ditch into a hay field owned by Don Brewster about half a mile south and half a mile east of Bellvue. It was found Saturday morning by a group composed of Mr. Brewster, Bill Vigil, A. Cameron, Victor Tamlin and Clarence Thomas.

Mr. Post's body was carried east through Bellvue, past the state fish hatchery and against the Colorado & Southern railroad tracks about one-fourth mile east and slightly south of the Bellvue store. It was found before noon Saturday by Wallace Stoker.

Mr. and Mrs. Johnson and their three daughters were on their way from Denver to their cabin, "Grandpa's Retreat," in Big Thompson canyon when their automobile became stalled close to the plaster mill west of Loveland.

Sought Help

Police Chief C. K. Steele of Loveland said Mr. Johnson had just got out of the car to go for help when the wall of water struck. He was carried across a field but managed to snatch some brush and hang on. Later he made his way to high ground.

The automobile, with his wife and daughters in it, was carried about one-fourth mile across the field and into the Big Thompson river. Searchers found the vehicle empty about 2 a.m. Saturday, after Mr. Johnson had reported his family missing.

The bodies were found Saturday by a group of 25 to 30 searchers working, under direction of Sheriff Ray M. Barger. Mrs. Johnson's body was found a mile from the Loveland fairgrounds by Lee Stratman. One body was found by Merle Seguine three-fourths mile from where the automobile went into the river.

Another of the daughters was found by Herbert Scheid at the south edge of the fairgrounds. The last body recovered was found by Eugene Walter about four miles west of Loveland at 1:40 p.m. Saturday.

—A & M COLLEGE, P. 7, Col. 2.

Six Inches in 2 Days

The storm was one of the most severe rainstorms to strike here in the last 15 years. With 2.95 inches of moisture which fell the previous night, it brought a total of 6.06 inches of rain to the Fort Collins area in a 27-hour period.

CITY WATER IS OK

Fort Collins city water was not contaminated by the recent floods and is pure to drink, City Manager Guy S. Palmes said Saturday after checking.

Health authorities advised persons drawing water from wells in the flooded area to boil it for human consumption, but the city water is all right.

The last previous time the A & M college campus was flooded was on Sept. 2 and 3, 1938, when a similar storm left 4.68 inches of moisture in a 18-hour period, according to Maxwell Parshall, meteorologist at the college weather station.

W. G. Wilkinson, district water commissioner, estimated Saturday that 8,000 second-feet of water would be a conservative figure for the flow of the Cache la Poudre river Thursday night. Saturday morning the flow had dropped to 5,600 second-feet. Recently the river flow had been about 750 second-feet.

Ditches Fill

Water from the flash floods immediately began pouring into ditches in the area west of here. These, mostly already full from the storm of the previous evening, began to overflow, flooding the nearby countryside, Mr. Wilkinson said.

Some of the ditches, including the North Poudre, Highline, Jackson and Eaton ditches, were unable to withstand the pressure of the increased water and their banks gave way at places.

Overflowing of the Highline ditch was not a factor in the flooding of the Colorado A & M campus, the district engineer said. Water flowing onto the campus, beginning about 10 p. m., filled the college oval to a depth of about four feet. It formed a lake covering the entire area of the oval.

Drains Slowly

The water drained slowly through an underpass beneath the C & S tracks west of the college gymnasium. H. L. Dotson, A & M vice-president, said about seven feet of water was shooting out of the narrow tunnel like a "torrent" after the water backed up on the oval.

The escaping water, after flooding the fieldhouse and gym, flooded across South College avenue and east on Locust street toward the east city limits. As a result, a 10-block area at the east edge of the city was inundated. Many houses and basements were flooded.

Residents Leave

The steady rising of the Poudre river resulted in flooding at Buckingham and Andersonville about 11 p.m. Friday. As a result, residents were advised to evacuate about midnight. The Salvation Army provided sleeping accommodations for all persons requesting them.

Fort Collins Coloradoan

Flood Loss Up To 3 Millions

Aug. 6, 1951

City Employes and Volunteers Carry On With Mop-up Job Here

Damage estimates for the northern Colorado floods of last Friday night and early Saturday rose to $3,000,000 today, with possibly $1,000,000 accounted for in the area of Fort Collins, Laporte and Bellvue.

The Associated Press listed other damage estimates as $100,000 at Loveland as a result of a flood wall turned loose in the Big Thompson river by the breaking of the Buckhorn reservoir dam 10 miles northwest of the city Friday night.

At Longmont the loss figure was put at $50,000, and at Lyons $35,000—all as a result of the overflowing of the South St. Vrain river. Another estimate placed damage to highways at $200,000.

Cleanup Job Goes On

As in all the flooded towns, public employes, residents and volunteer workers in the Fort Collins area continued today their task of pumping out flooded basements of homes and stores, draining off stagnant pools, drying out carpets, rugs and furniture, and removing muddy sediment deposited by the flood waters.

A Fort Collins works department crew began spraying the entire area of Buckingham, east of the city, with disinfectant to avert a danger of epidemic disease. This work also was to be done in the flooded Locust and [illegible] street and Eastdale drive sections in the southeast of the city.

City Manager Guy H. Palmes said also that powdered disinfectant would be available for residents desiring to do spraying themselves.

Third Day of Work

Approximately 70 city employes—policemen, firemen and workers in the water, street and light departments—today began their third day of cleaning up after the flood. All shifts of all departments have been working since Friday.

Their efforts were supplemented Sunday by those of about 40 volunteers, who responded to a call from Frank Ghent, city commander of the World war II civil defense organization.

All available city pumps, and others privately owned, were put to work in the city and in Buckingham to pump out home and store basements. The fire department worked pumps at the America and Trail theaters, the Bickford building, the Walgreen drugstore and the State drygoods store. The firemen also had worked Friday, following Thursday night's initial and lesser flood.

Looting Reported

Police said they received one report of looting in Buckingham. Several men kept up patrols of the neighborhood Friday night and Saturday.

Capt. Clenton Irby of the Salvation Army said he had provided clothing and shoes for a few Buckingham residents, who were evacuated when the Cache la Poudre river overflowed Friday night.

He had received $26 in donations this morning, to be used in paying bills for about 60 persons housed in hotels Friday night. Others were accommodated at the Army hall and in homes. All returned to their homes Saturday.

Captain Irby said the Salvation Army at Denver sent two truckloads of clothing for flood relief at Loveland.

At A & M Building

A city fire engine this morning was at work pumping out 9½ feet of water in the Colorado A & M college physics building. Its pumps poured 600 gallons of water a minute from the basement. Firemen also operated a smoke ejector to dry out the basement of the Poudre Valley National bank, where seeping water inflicted some damage on stored stationery.

Fort Collins' police radio station was the communications center not only for city operations, but also for Loveland police and the State Highway patrol. In addition, both police telephone lines were kept busy with almost constant calls Saturday.

Swimming Pool OK

The city swimming pool was pronounced suitable for swimming today by Mr. Palmes. The rest of Sheldon's lake, however, was covered with scum, which will be treated with chlorine HTH and blue vitriol.

City employes and volunteers spent Sunday in the Locust-Plum street flood area, cleaning basements, moving soggy furniture and helping residents in various ways.

Calls for help were still being received today.

Flood at Dale

Reports to the city manager today said a substantial part of the highway water in the Poudre river came from a cloudburst area in the Virginia Dale section. This flooded down the North Poudre and filled the main Poudre almost bank-full.

Halligan reservoir, north of Livermore, was filled with rainwater, dotted with dead cattle and debris.

Another part of the Poudre flood came from the flash flood in Little Buckhorn (or Dry) creek, west of Bellvue, which drowned Mr. and Mrs. George Post and Aden E. Webb.

Drying Out

Although Locust and Plum streets and Eastdale drive were dry this morning, the yards of many houses along those streets contained rugs and furniture drying in the sun. One resident spread several carpets to dry on the street pavement.

The Poudre canyon highway was open today, but many rocks and other debris remained for removal by county road workers.

Fort Collins Coloradoan - Aug.7, 1951

Flood Loss $2,000 For Poudre Canal

Flooding of the Little Buckhorn creek near Bellvue last Friday night caused an estimated $2,000 damage to the Poudre supply canal northwest of here, C. E. Klingensmith, engineer in charge of the Reclamation bureau's Fort Collins office, reported today.

Only minor damage resulted from the storm at other projects supervised by the local office. Excess water was a nuisance at all the projects, however, and interrupted work schedules.

About 10 12-foot long panels of the concrete lining of the Poudre supply canal, completed only July 19 by the Peter Kiewit Sons company of Denver, were buckled by the flood waters. Most of the expense of replacing them will result from the fact the work will have to be done by hand, rather than with lining machinery.

Some Time Lost

Some debris also was washed into the canal and a few of the culverts beneath the patrol road alongside the canal were half filled with sand and gravel.

The G. L. Tarleton company of St. Louis, Mo., which has a $1,955,187 contract for constructing the four tunnels, diversion dam and a siphon of the North Poudre supply canal, was inconvenienced by the flood waters. Four or five scheduled work shifts had to be cancelled.

Mr. Klingensmith reported that, as of Aug. 1, the company had completed about eight per cent of the work covered by its contract. Crews have been working on all the features of the project except the diversion dam to be built above the Fort Collins waterworks.

Work Round the Clock

Portal cuts on all four tunnels have been almost completed, except for the inlets to tunnels 1 and 2. About a quarter of a mile of tunnel 2, which will be 4,670 feet long when completed, had been excavated by Aug. 1.

The drilling work is being carried on from the tunnel's east portal, about 1½ miles west and the same distance north from Ted's place. The tunnel work is on a 24-hour basis.

Flood water Friday evening also washed away some of the new earthwork recently placed by the Adler Construction company of Loveland, which has a $756,450 contract to build the canal features of the North Poudre supply canal.

Some extra excavation work will be required as a result. The company also had to stop work for several days to allow the ground where the work is being carried on to dry out.

Extension Third Done

Mr. Klingensmith reported the Adler company had completed four per cent of the work covered by its contract up to Aug. 1. Most of this was earthwork done between tunnels 2 and 4.

The Paul G. Van Sickle company of Denver has completed 30 per cent of the Windsor extension of the Poudre supply canal. It presently is installing culverts and has completed 200 feet of concrete lining.

The floods caused no damage to Horsetooth reservoir, so far as is known, Mr. Klingensmith said. He added flash floods west of the reservoir probably washed some soil into the reservoir. How much, if any, the floods raised the water level in the reservoir is not known at the office here.

The Trans-Eelectric company of Nashville, Tenn., which is constructing the $378,000 Flatiron-Fort Collins-Cheyenne tap power transmission line, had completed two per cent of the work by Aug. 1. Virtually all the work done on the 36-mile line so far has been clearing of trees from the right-of-way.

Malcolm W. Larson, Denver contractor, has completed 17 per cent of the work on the Brighton - Hoyt - Brush power transmission line. Poles for the line already have been set for a distance of 22 miles.

The Beaver creek substation was 99 per cent completed as of Aug. 1. Fifty-two per cent of the work on the Fort Morgan addition to the substation there had been completed.

Appendix A

The following data concerning the flood of August 2-3, 1951 was taken from a report by the Corps of Engineers, Omaha District dated January 1952 entitled "Report on Floods in the Omaha District During the Calendar Year of 1951."

W. CACHE LA POUDRE RIVER AND TRIBUTARIES, COLO.
(Tributary of South Platte River)

Flood of 3 August

1. Cause.- During the afternoon and night of 3 August, a heavy rainstorm occurred over the frontal range and foothills of the Rocky Mountains east of the Continental Divide from the vicinity of Boulder to near Fort Collins, Colorado, a distance of approximately 50 miles. A "bucket survey" of the storm area indicated precipitation averaging about 9.4 inches occurred over about 97 square miles. Approximately 12 inches of rainfall occurred near Bellevue, Colorado, which is in the Cache La Poudre River drainage area. Runoff from this storm caused a severe flood on the Cache La Poudre River and on its tributary, Dry Creek. An isohyetal map of the storm is contained in Appendix II.

2. Extent.- Overbank flow occurred along practically the entire length of the Cache La Poudre River, Dry Creek, and many of its lesser tributaries.

3. Duration.- The flood period was approximately 2 days.

4. Stages and discharges.-

a. Cache La Poudre River 4 miles above mouth of Dry Creek.- Two sharp peaks were observed at the stream gaging station at this point. The highest occurred at 9:50 p.m., 3 August with 5.8 feet stage and 4,910 c.f.s. indicated discharge.

b. Cache La Poudre River at Laporte, Colorado.- The discharge of the Cache La Poudre River at Laporte, 1.75 miles below the mouth of Dry Creek, was determined by the contracted bridge-opening method. At this point the channel is divided into two channels, each crossed by a bridge. The peak flow was approximately 12,000 c.f.c.

c. Cache La Poudre River near Greeley, Colorado.- A stream gaging station near Greeley recorded a crest stage of 8.0 feet at 3:00 p.m., 5 August. A peak flow of 3,700 c.f.s. was indicated.

d. Dry Creek near Bellevue, Colorado.- The flood crest arrived at this point at 11:00 p.m., 3 August. Slope-area measurements indicated the peak flow was about 8,000 c.f.s.

5. Damages.- The flood on the Cache La Poudre River below the mouth of Dry Creek overflowed large areas of cropland and caused severe crop damage. Numerous houses and farm buildings were flooded. About 100 feet of levee near Fort Collins, Colo. was washed out. Severe damage resulted to numerous irrigation dams, headworks, and canals. At Fort Collins, runoff from a small draw flooded a portion of the Colorado State College campus and overflowed irrigation ditches. The power plant, physics building, library, gymnasium, and student union were flooded on 3 August. The water in the power plant was 5.5 feet deep. The water from the campus flowed eastward to inundate a 10-block area in the eastern part of Fort Collins. Many homes and basements were flooded.

6. The flood on Dry Creek washed away or seriously damaged practically everything in its path, including homes, bridges, roads, farm buildings and equipment. Three human lives were lost and many homes were washed away and others damaged near Bellevue. About 400 feet of the Pleasant Valley and Lake irrigation canal was washed out. Dry Creek cut new and wider channels in many places to cause considerable loss of land. Relatively large areas of croplands were inundated and heavy crop losses resulted. The State Fish Hatchery at Bellevue was flooded and thousands of small trout were lost.

7. Estimate of damages.- (By Denver area)

Cache La Poudre River:	Direct	Indirect	Total
Agriculture	$38,200	$10,000	$48,200
Levees	300	0	300
Business	4,300	0	4,300
Urban	2,000	300	2,300
Utilities	1,600	200	1,800
Irrigation ditches	6,000		6,000
Railroad	10,000	2,000	12,000
Roads and bridges	20,000	2,000	22,000
Total	$82,400	$14,500	$96,900
Dry Creek:			
Agriculture	$15,400	$ 5,000	$20,400
Irrigation ditches	1,300	0	1,300
Urban	6,900	500	7,400
Railroad	1,200	300	1,500
Fish hatchery	25,400	5,000	30,400
Municipal property	1,400	200	1,600
Roads and bridges	10,000	1,000	11,000
Miscellaneous damage	2,700	0	2,700
Total	$64,300	$12,000	$76,300
Colorado State College			$270,000
Grand total of damages			$443,200

X. BIG THOMPSON RIVER AND TRIBUTARY, COLORADO
(Tributary of the South Platte River)

Flood of 3 August

1. General.- The Big Thompson River, one of the largest tributaries of the South Platte River, rises in the mountains west of Estes Park, Colorado. About 6 miles west of Loveland, Colorado, it leaves the mountains and traverses rolling plains for about 29 miles to join the South Platte River near La Salle, Colorado. Buckhorn Creek, a tributary of Big Thompson River, drains the frontal range and foothill regions, and enters the Big Thompson River from the north about 5.5 miles west of Loveland. In 1906 an irrigation company constructed Buckhorn Dam on Buckhorn Creek about 1.5 miles above the mouth. It was an earth fill structure about 1,500 feet long and 30 feet high, and had a small spillway on the east end of the dam. An additional concrete spillway was added on the west end of the dam in 1923 after a small washout occurred. In 1931 the dam was raised 2 feet. With two feet of freeboard on the dam, the spillways had a combined capacity of about 2,800 c.f.s. Normal releases from the reservoir were controlled by four small sluice gates adjoining the west spillway. At the level of the spillway crest, the reservoir impounded about 626 acre-feet of water.

2. Cause.- Heavy precipitation occurred over the watershed of Big Thompson River and adjacent areas on 2-3 August. A "bucket survey" of the storm area indicated total precipitation for the storm of over 12 inches at the center, and an average of 9.4 inches over an area of 97 square miles. An isohyetal map of this storm is contained in Appendix II. Runoff from this storm caused high stages on streams draining the storm area. Flooding resulted on the Big Thompson River and on its tributaries, Buckhorn, Redstone, and Dry Creeks. The runoff from Buckhorn Creek and its tributary, Redstone Creek, overtopped Buckhorn Dam and caused its failure. The waters released from Buckhorn Reservoir caused major flooding downstream therefrom on Buckhorn Creek and Big Thompson River. Three breaks, totaling about 460 feet in length with a maximum depth of 35 feet occurred in the dam.

3. Extent.- Severe overbank flow occurred on the Big Thompson River from the mouth of Buckhorn Creek to its confluence with the South Platte River. Moderate flooding occurred on Buckhorn Creek above the dam and on its tributary, Redstone Creek, on Big Thompson River above the mouth of Buckhorn Creek, and throughout the entire length of Dry Creek.

4. Duration.- The flooding lasted for about 3 days.

5. Stages and discharges.-

a. Buckhorn Reservoir.- A peak flow of 15,000 c.f.s. occurred on Buckhorn Creek at a gaging station 1.5 miles above the dam at 9:15 p.m., 3 August. Buckhorn Dam was overtopped at 9:30 p.m. and broke at 10:00 p.m. At 10:30 p.m. the waters below the dam were rapidly receding and were back in banks at midnight. At the time the dam failed an estimated 1,000 acre-feet of water were impounded in the reservoir. The estimated peak flow just below the dam shortly after it failed was about 26,000 c.f.s.

b. Redstone Creek.- A slope-area determination by the U.S. Geological Survey near Masonville, Colorado, indicated a peak discharge of about 14,000 c.f.s. occurred on Redstone Creek on 3 August.

c. Big Thompson River.- A peak flow of 6,000 c.f.s. was recorded at the gaging station at Canyon Mouth. At the stream gaging station near Loveland the flood crested at 11:30 p.m., 3 August with a stage of 6.74 feet and a discharge of 22,000 c.f.s. At State Highway No. 257 bridge about three miles southeast of Loveland the peak flow, estimated from a contracted-opening determination, was about 11,400 c.f.s.

6. Damages.- The failure of Buckhorn Dam caused a severe and destructive flood on the Big Thompson River. From the mouth of Buckhorn Creek to Loveland, Colorado, the Big Thompson River was a raging torrent, as much as a mile wide in places. Below Loveland the width of the flood area was gradually reduced as the flood progressed downstream. The flood swept away or damaged everything in its path above Loveland. Numerous farm homes and other rural homes were flooded, many being either swept from the foundations or

otherwise wrecked by the torrent. One mile of blacktop surface was washed from U. S. Highway No. 34 west of Loveland. Diversion dams, headworks, and irrigation canals were destroyed, and considerable areas sustained loss of crops, and damage from sediment and erosion. Four human lives (the Johnson Family) were lost, and many persons were left homeless by the flood.

7. Estimate of damages.- (By Denver area)

	Direct	Indirect	Total
Agriculture	$213,400	$54,900	$268,300
Urban	12,400	1,900	14,300
Business concerns	51,100	4,900	56,000
Highways and bridges	80,000	8,000	88,000
Railroads	20,000	4,000	24,000
Irrigation structures	150,000	-	150,000
Utilities	2,000	-	2,000
Total damages	$528,900	$73,700	$602,600

Y. FISH CREEK, COLORADO
(Tributary of Big Thompson River)

Flood of 25 May

1. Cause.- On 25 May, flooding occurred on Fish Creek from failure of Lilly Lake Dam. Fish Creek is a small tributary of Big Thompson River. Lilly Lake Dam was located on the headwaters of Fish Creek about 5 miles south of the town of Estes Park, Colorado. The dam was an earth structure, 5 or 6 feet in height and about 300 feet long. A shallow unlined spillway at the north end of the dam was partially blocked by deposits of sand and driftwood. The impounded waters, covering about 18 acres, were known as Lilly Lake. In the early morning of 25 May, high winds created excessive waves on the lake, which overtopped and caused failure of the dam. The sudden release of the lake waters caused a damaging flood on Fish Creek.

2. Extent.- Serious flooding occurred on Fish Creek from Lilly Lake Dam to Estes Lake, into which Fish Creek drains enroute to the Big Thompson River.

3. Duration.- Lilly Lake Dam failed just before 5:00 a.m., 25 May, and in a few hours the impounded waters had passed downstream.

4. Stages and discharges.- Failure of the dam released an estimated 85 acre-feet of impounded water. Just below the dam the peak flow was estimated at about 2,500 c.f.s. The peak of the flood arrived at the gaging station at 6:10 a.m., 25 May. Independent slope-area measurements of the peak flow in the vicinity of the gage by the representatives of the Corps of Engineers and of the U. S. Geological Survey gave discharges of 1,180 c.f.s. and 1,500 c.f.s., respectively.

5. Damages.- The failure of Lilly Lake Dam caused a great rush of water and debris which traveled down Fish Creek with a standing wave. The flood carried everything in its path, including uprooted trees, mud, gravel, boulders, fragments of bridges, and other debris. Mud, gravel, and boulders were deposited along the course of the flood over widths varying from 100 to 500 feet. About 150 acres of land were inundated, most of which was pasture. Three county road bridges were washed away and parts of the road which parallels the creek were destroyed. Several telephone and electric power lines were cut. Two homes on a ranch about 1.5 miles downstream from Lilly Lake Dam were damaged; the floodwaters entered the basement garage of one home, and was about 2.5 feet deep on the first floor of the other. A small foot bridge at the same location was destroyed. No human lives or livestock were lost.

6. Estimate of damages.- (By Denver area)

Buildings	$ 500
Bridges and culverts	1,100
Highway No. 7	7,000
County roads	1,000
Pasture	500
Total damages	$10,100

Z. ST. VRAIN CREEK AND TRIBUTARIES, COLO.
(Tributary of South Platte River)

Flood of 3 August

1. Cause.- During the afternoon and night of 3 August, a heavy rainstorm occurred over the frontal range and foothills east of the Continental Divide from the vicinity of Boulder to near Fort Collins, Colorado, a distance of approximately 50 miles. A "bucket survey" of the storm area revealed three centers of high intensity rainfall. Two of these were within the St. Vrain Creek watershed, near the towns of Lyons and Niwot, respectively. At Lyons the rainfall, described as a cloudburst which started about 6:00 p.m., 3 August, totalled 6.3 inches. At the storm center near Niwot, total precipitation was unofficially reported to have been over 6 inches. An isohyetal map of the storm is contained in Appendix II. The runoff from this storm caused flooding on St. Vrain Creek and on its tributaries, Dry Creek and Lefthand Creek.

2. Extent.- Overbank flow occurred on St. Vrain Creek from the vicinity of Lyons, Colorado, to the mouth, and on Dry Creek and Lefthand Creek throughout practically their entire lengths.

3. Duration.- No exact data are at hand, but it appears the flood period was less than 12 hours.

4. Stages and discharges.-

a. St. Vrain Creek at Lyons, Colorado.- Crest stage of 5.85 feet on 3 August and 3,700 c.f.s. indicated discharge.

b. St. Vrain Creek 7 miles east of Longmont , Colorado.- (Below mouth of Dry Creek) A contracted-opening determination at the U. S. Highway No. 185 bridge at this point indicated the peak discharge was approximately 6,200 c.f.s.

c. Dry Creek near Niwot, Colorado.- From slope-area measurements at a point 1.5 miles south of Niwot, the peak discharge appears to have been about 5,700 c.f.s. The flood crest occurred at this point at about 9:50 p.m., 3 August.

d. Dry Creek near Longmont, Colorado.- The flood crest swept over U. S. Highway No. 287 two miles south of Longmont at 10:45 p.m., 3 August. No discharge measurements were made at this point.

5. Damages.- The flood on Dry Creek was 0.25 mile in width in places, and swept away crops, buildings and equipment, and forced about 50 persons to move out of their homes. Railroad and highway embankments were washed out in a number of places and several bridges were destroyed. The South St. Vrain Highway above Lyons and railroad and highway bridges on St. Vrain Creek near Longmont were severely damaged. Considerable shocked grain left standing in the fields was washed away. No human lives were lost and no loss of livestock was reported.

6. Estimate of damages.- (By Denver area)

Dry Creek:	Direct	Indirect	Total
Residences (urban)	$ 1,600	$ 500	$ 2,100
Farms	19,300	1,200	20,500
Utilities	500	0	500
Railroads	15,000	1,700	16,700
Irrigation works	5,500	3,000	8,500
Bridges	5,300	1,000	6,300
Roads	2,000	500	2,500
Total	$49,200	$7,900	$57,100
St. Vrain Creek:			
Urban	$ 1,000	$ 100	$ 1,100
Agriculture	500	200	700
Railroad	12,000	1,500	13,500
Bridges	1,200	100	1,300
Roads	2,500	1,000	3,500
Irrigation	500	200	700
Total	$17,700	$3,100	$20,800

Lefthand Creek:	Direct	Indirect	Total
Agriculture	$1,200	$100	$1,300
Bridges	1,000	100	1,100
Roads	300	100	400
Irrigation	2,500	500	3,000
Total	$5,000	$800	$5,800
Grand total damages	$71,900	$11,800	$83,700